(1) TITLE OF THE INVENTION

Detector for a Measuring Device

(2) BACKGROUND OF THE INVENTION

(i) Field of the Invention

The invention relates to a detector for a device used to measure radioactive areas, in which the device has two electrodes between which a voltage is applied, and also has a counter gas between the electrodes.

(ii) Description of the Prior Art

The measuring of radioactive areas is carried out in particular to determine radioactive thin-film plates, paper chromatograms, electrophoretograms, thin sections of small animals, DNA plotting strips or contamination. For this purpose, a Geiger-Müller counter or a proportional counter tube is used. In use, these measuring devices are moved slowly over the surface to be measured and the radioactivity measured is recorded, for example, by a rate meter, counter and plotter.

When an area is measured by means of a proportional counter tube, the latter is incrementally advanced along the pathway to be scanned. Another possibility is to use several individual counter tubes arranged one behind the other.

It is further known in the art that radioactive areas on surfaces can be determined with the aid of a wire mesh detector (multiwire detector). The counter gas between the suspended wire meshes, which are insulated from each other, becomes ionized in the radioactive zones and the location of the radioactive areas in the wire mesh can be displayed on a screen using known electronic methods of measuring radioactivity. The local distribution of the radioactivity in a sample can also be recorded photographically.

It is also known in the art that the distribution of radiation on surfaces can be measured by applying a layer of photographic emulsion which is blackened by the radiation (autoradiography). The disadvantage of this method is that, depending on the amount of activity, long exposure times of up to several months have to be tolerated. Recently, however, autoradiography has been further developed. In order to avoid long exposure times, a layer of phosphorus, for example, was used. Electrons in this layer

of phosphorus became excited and can be converted into an optical image by scanning them with a laser beam. The disadvantage of this method, however, is that quantitative determination of the local distribution of the radioactivity is unsatisfactory.

When a multiwire detector is used, the spatial resolution of closely adjacent areas of radioactivity is poor, because obliquely incident radiation also triggers ionization of the gas. An attempt has been made to eliminate this deficiency by using a multi-hole collimator between the radioactive surface and the detector. However, this has the disadvantage that the sensitivity of the measuring device is considerably reduced. In addition, it has been discovered that the lack of rigidity and stability of wire meshes used as electrodes can give rise to problems as regards the reproducibility of the measurements.

(3) SUMMARY OF THE INVENTION

(i) Aims of the Invention

A main object of the present invention is to provide an improved detector in which the local resolution is further improved.

Another object of another aspect of this invention is to improve the reproducibility of the measurements.

(ii) Statements of Invention

The present invention provides a detector for a device for measuring radioactive areas, the device having two electrodes between which a voltage is applied, and also having a counter gas. The electrodes are arranged on opposite surfaces of a support and include channels which pierce the electrodes and the support. In this way, the counter gas is in contact with the electrodes via the channels.

The present invention also provides a measuring device comprising: a detector having two electrodes between which a voltage is applied, and also having a counter gas, the electrodes being arranged on opposite surfaces of a support, and including channels which pierce the electrodes and the support whereby the counter gas is in contact with

the electrodes via the channels; and a housing, at least one wall of which is transparent to the type of radiation to be measured. The detector is disposed in that housing.

(iii) Other Features of the Invention

By one feature of the device for measuring radioactive areas, the electrodes are arranged directly on the support, and the support consists of an electrically non-conducting material.

By another feature of the detector for the device for measuring radioactive areas, an insulating layer is provided between each of the electrodes and the support.

By yet another feature of the detector for the device for measuring radioactive areas, the support consists wholly or partially of a ceramic material.

By still a further feature of the detector for the device for measuring radioactive areas, a plurality of first and second electric conductors is arranged over the channels, the first conductors extending in a first direction and the second conductors extending in a second direction, the conductors being connected to an evaluation unit. By one auxiliary feature of that feature of the device for measuring radioactive areas, the diameter of the channels is between about 0.2 and about 0.005 mm. By another auxiliary feature of that feature of the device for measuring radioactive areas, the spacing between adjacent channels is about 0.1 to about 1 mm.

By yet another feature of the detector for the device for measuring radioactive areas, the spacing between the electrodes is adjusted, preferably in the range from about 3 to about 10 mm, according to the energy of the particles or quanta to be measured.

By still a further feature of the device for measuring radioactive areas, the pressure of the counter gas can be varied according to the energy of the particles or the quanta to be measured.

By one feature of such device for measuring radioactive areas, the counter gas is a mixture of neon, helium and methane. By one auxiliary feature of that feature, the counter gas contains about 30% to about 95% neon by volume, 0 to about 65% by volume helium, and about 3.5% by volume methane. By another auxiliary feature of that

feature, the counter gas contains about 65.5% by volume neon, about 30% by volume helium, and about 4.5% by volume methane.

(iv) Generalized Description of the Invention

As described in detail above, the detector according to the present invention has electrodes which are arranged on opposite surfaces of a support. In addition, channels are provided which pierce the electrodes and the support, so that the counter gas is in contact with the electrodes via these channels.

The counter gas fills the individual channels. Thus, each channel acts both as a collimator and as a counter tube in which the gas is ionized once radioactivity penetrates the channel, and finally photoexcitation is triggered as a result of the avalanche effect. This can be easily and rapidly detected, for example, by known photographic methods. An image is obtained of the distribution of the radioactivity over the surface to be measured through the totality of the channels in the detector according to aspects of the invention. In addition, almost 100% detectability of the particles or quanta travelling vertically in relation to the measurement plane is obtained, and deterioration of the local resolution caused by particles or quanta travelling along obliquely oriented paths is prevented.

The detector as such is rigid and robust, thus guaranteeing reproducibility of the measurements.

In accordance with an advantageous further improvement, the electrodes are arranged directly on the support. The latter consists of an electrically non-conductive material. The support may consist wholly or partially of a ceramic material. Other materials, e.g., TEFLON® (trade-mark for polytetrafluoroethylene) or epoxide, are possible.

The support may also be made of an electrically-conducting material. In this case, a layer of insulation should be provided between the electrodes and the support. The use of an electrically-conductive material may be of interest if this simplifies the formation of the channels.

In accordance with a further improvement according to the present invention, first and second electrical conductors may be arranged over the channels. The first conductors extend in a first direction and the second conductors extend in a second direction. The first and second conductors form a grid-like mesh. The individual conductors are electrically-insulated from each other. The individual conductors running in both directions in the same plane, which is parallel to the plane of the electrode, act as triggering electrodes for the ionization processes in the individual channels. If an ionization process is triggered in a channel, a voltage is induced at the point of intersection of the two sets of conductors. This voltage can be evaluated in an evaluation unit and can be displayed, for example, on a screen. By means of this improvement, it is possible to dispense with evaluation by photographic means. As a result, the measuring time can be reduced. It is advantageous to keep the diameter of the channels between about 0.2 and about 0.05 mm.

The spacing between adjacent channels is advantageously kept at about 0.1 to about 1 mm.

The spacing between the electrodes should preferentially be between about 3 to about 10 mm. However, this spacing can be adapted to the energy of the particles or quanta to be measured.

Instead of adapting the spacing between the electrodes, the pressure of the counter gas may be varied according to the energy of the particles or quanta to be measured. This has the advantage that, by varying the pressure, it is possible, using a detector, to measure different particles or quanta.

It has been discovered that the counter gas should advantageously consist of a mixture of neon, helium and methane. Methane is used here as a quenching gas.

(4) BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

Figure 1 is a perspective view of a detector, according to an embodiment of the invention;

Figure 2 is a perspective view of a detector according to an embodiment of this invention; and

Figure 3 is a perspective view of a detector mounted in a housing according to an embodiment of the invention.

(5) DESCRIPTION OF PREFERRED EMBODIMENTS

(i) Description of Figs. 1 and 2

As shown in Figs 1 and 2, the detector 7 comprises two electrodes 1, 2 between which a voltage V is applied. The electrodes 1, 2 are arranged on opposite surfaces 4, 5 of a support 3. Channels pierce the electrodes 1, 2 and the support 3. The counter gas Z is in contact with the electrodes 1, 2 via the channels 6.

The detector 7 possesses a plurality of channels 6. The channels are formed in the two directions X and Y and are equidistantly spaced from each other. Each channel acts as a collimator and a counter tube.

First and second electrical conductors 8, 9, are arranged over the channels 6. The first conductors 8 extend in a first direction, namely the X-direction in the view presented here. The second conductors 9 extend in a second direction (Y-direction). The individual conductors 8 and 9 are electrically insulated from each other.

The point of intersection 8, 9 is positioned over the channels 6. Each individual conductor 8, 9 is connected with an evaluation unit, which is not shown here. The conductors 8 or 9 may be installed in an electrically non-conducting layer. These layers may be applied directly to an electrode. The layers may also be arranged at a distance from the electrode.

An ohmic resistor can be provided at each conductor. A constant voltage is applied to each conductor. If ionization occurs in a channel 6, a voltage is induced in

the conductors 8, 9 assigned to the channel 6. From the change in voltage in the individual conductors 8, 9, it is possible to determine the location of the event.

(ii) Description of Fig. 3

As seen more fully in Fig. 3, the detector may be disposed in a housing 10. The housing 10 possesses a gas inlet 11 and a gas outlet 12. The wall 13 which is opposite to the electrode 1 is provided with an opening 14 corresponding to the electrode 1. By means of a device not shown here, it is possible to position a layer of photographic emulsion over the opening 14.

If a detector is used in a housing, as shown in Fig. 3, the inner chamber formed by the housing and a closure, not shown here, of the opening 14 must be flushed out using a flushing gas. Once the inner chamber has been flushed out, a counter gas is introduced into the inner chamber. The gas pressure in the inner chamber is measured and held constant by regulating means, which is not shown here, in order to achieve uniform sensitivity.

Instead of the opening 14, the wall 13 may consist of a material which is transparent to the type of radiation being measured. The housing of the detector may then be hermetically sealed so that no gas losses occur.

6. CONCLUSION

From the foregoing description, one skilled in the art can easily ascertain the essential characteristics of this invention, and without departing from the spirit and scope thereof, can make various changes and modifications of the invention to adapt it to various usages and conditions. Consequently, such changes and modifications are properly, equitably, and "intended" to be, within the full range of equivalence of the following claims.